## Space Weather Forecast

Issued on Monday, 26 December 2022 at 12:45 Local

**This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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### Space Weather Forecast Headline: A disturbed period: Minor or possibly initially Moderate Geomagnetic activity from a series of CMEs and fast wind regimes likely.

### Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar activity has been low over the last 24 hours, with X-ray activity confined to occasional low-level Common-class activity, with this mostly from the largest and most complex group on the Sun, as in recent days. This group showed some movement in its diffuse trailing region, with slight spreading and decay. A new sunspot developing near the northeastern solar horizon developed significantly over the preceding hours, eventually producing a late peak flare of the 24 hours at 26/1011UTC.

There were up to seven sunspot regions on the Sun in the 24 hours, including the two mentioned above. Of the remainder, the most noteworthy was perhaps one in the southwest which saw some proliferation of spots, while the rest of the Earth-facing side was less notable and either stable or in slow decay.

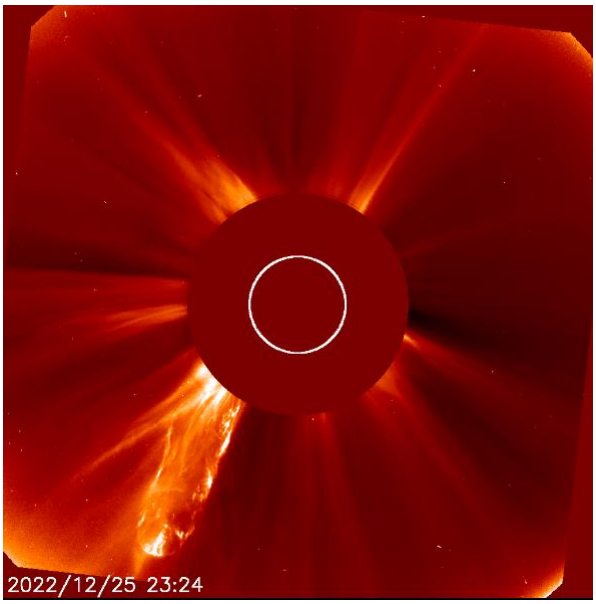


**Figure 1: False-colour satellite coronagraph imagery of the 25/2130UTC prominence erution from the southeastern solar horizon. This feature is not expected to affect Earth, being directed both east of (left on this image) and below the Sun-Earth line.**

Two main 'prominence eruptions' (arcs of plasma ejected from the edge of the Sun) were observed from the eastern solar horizon in the period: firstly a northeast event at 25/1800UTC

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from near the arriving sunspot. This may have subsequently been followed by more minor releases along the same track. Secondly, a large and energetic event was seen from the southeast at 25/2130UTC. This latter feature was directed well south and east of the Sun-Earth line to no presumed effect at Earth. No new Coronal Mass Ejections (CMEs) were therefore in evidence in the past 24 hours.

**Solar Wind / Geomagnetic Activity:** Measurement of solar wind speeds, was hampered by the effects of low numbers of particles at the recording instruments, with the result that detail in solar wind measures has been more erratic and less precise than is typical over the past 24 hours. This being said, the Earth appears to remain influenced by a fast wind regime. A related instrument is currently showing a sharply rising trend in numbers of particles being detected, which may represent an impending Coronal Mass Ejection (CME - perhaps most likely that emitted 24/0230UTC), however this will become clearer in the coming hours.

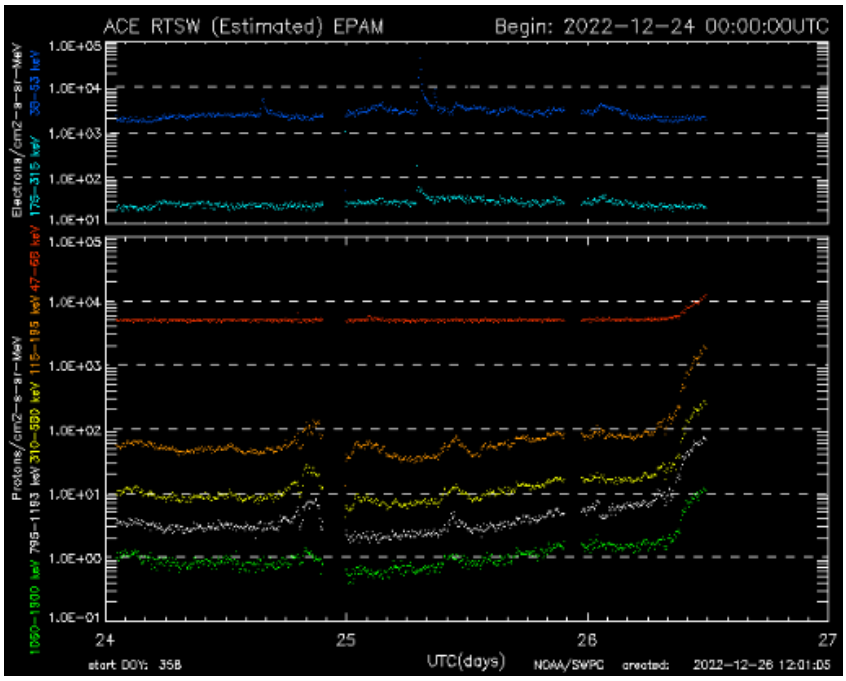


**Figure 2: Instrument readings at a satellite on the Sun-Earth line around 1 million miles from Earth in the 93 million mile diostance to the Sun. The measured density rises shown (sharply rising numbers of low energy protons on 26 December) are sometimes indicative of an impending CME - perhaps most likely the northeastern 'filament eruption' from 24/0230UTC. This will become clearer into the UTC afternoon.**

The solar wind speed appears to have risen from Slightly Elevated to Elevated levels in the period, with an initial slight fall then reversing after 0300UTC. The number of particles was anomalously low in the period, but apparently near background levels throughout. The magnetic field of these particles rose in the period, peaking at Slightly Elevated levels, while the north-south component was a little more modest but spending much of the period anti-aligned with Earth's field.

In spite of the prolonged anti-aligned (with Earth's field) magnetic field, provisional geomagnetic activity was mainly quiet, but with a rising tendency to fall just short of Minor Geomagnetic Storm in the 09-12UTC interval.

**Energetic Particles / Solar Radiation:** No solar radiation storms were observed.

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## Four-Day Space Weather Forecast Summary

**Solar Activity:** Solar activity is expected to be mainly at low levels, with a slight chance of moderate-class X-ray flares, mainly from the largest sunspot group, and perhaps now the new northeastern horizon sunspot group.

**Solar Wind / Geomagnetic Activity:** Three possible CMEs feature in the forecast period, two which left the Sun on 24 December and one from 25 December. Possible arrivals start from late day one, 26 December and into early 27 December, then again on 29 December. The cadence of CMEs over the Christmas period and arising phasing mismatches of these CMEs may make identifying individual events difficult, however.

There are up to three fast wind-generating coronal holes due in the four days, however one is already in course, and in any case identification of movement between them is likely to be difficult.

All considered, geomagnetic activity is forecast to rise over day one to likely G1/Minor Storm intervals, due to possible CME arrival(s) and a chance of these combining with a fast wind. There is a slight chance of G2/Moderate Storm given the potential for a more direct arrival of the 24/0230UTC CME in particular. Geomagnetic activity should then likely become quieter 28 December, before a Chance of further G1/Minor Storm intervals on 29 December due to either glancing CME incidence or yet another fast wind arrival.

**Energetic Particles / Solar Radiation:** There is a daily slight chance of reaching S1 levels, largely as a result of the largest sunspot's westward progression.

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**Geomagnetic Storms:**

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 50 | 50 | 20 | 30 |
| Strong | G3 | No | 5 | 5 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

**Radio Blackouts - X Ray Flares:**

| X Ray Flares Probability | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | R1-R2 M Class | No | 25 | 25 | 25 | 25 |
| Very Active | R3 to R5 X | No | 1 | 1 | 1 | 1 |

**Solar Radiation Storms - (High Energy Protons):**

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ S1 | No | 5 | 5 | 5 | 5 |
| Very Active | ≥ S3 * | No | 1 | 1 | 1 | 1 |

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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